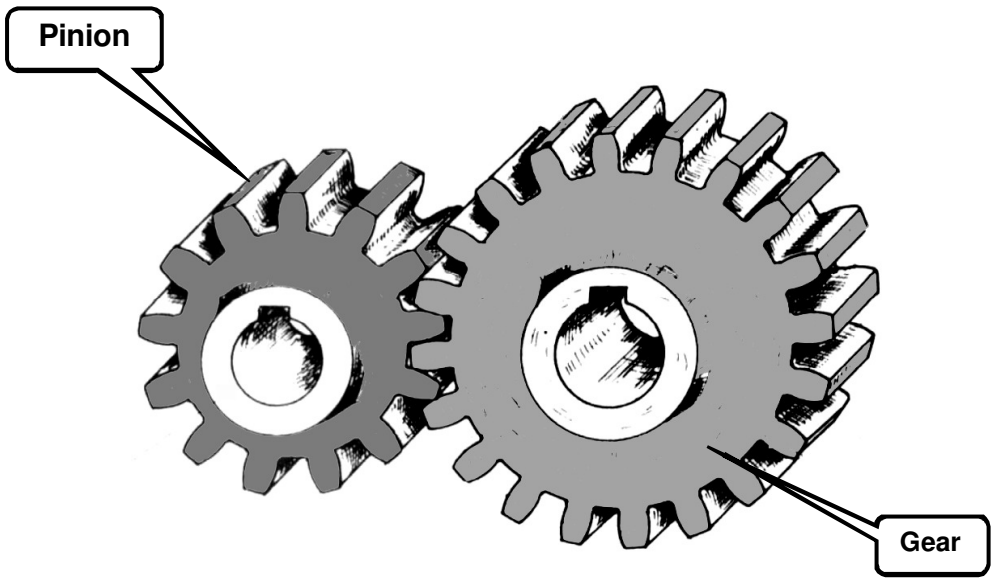
Gearing

Meshing Gear Pair



Involute Profile

Involute Profile

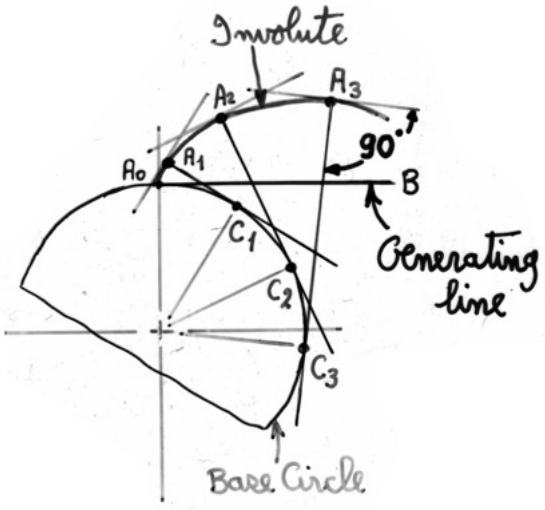
Rolling of line A_0B around the circle (No Slipping)

Involute : $A_0\ A_1\ A_2\ A_3 \ldots$

$\overset{\frown}{A_0C_1} = \overline{A_1C_1}$, $\overset{\frown}{A_0C_2} = \overline{A_2C_2}$

Tooth Profile → Involute

- Simple profile
- Interchangeability of gears



SJE Gearing ٣

Involute Profile

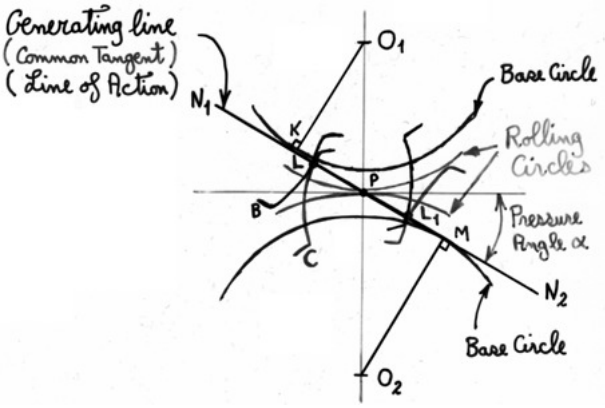
N_1L draws involute BL

N_2L draws involute CL

L : Point of contact of involutes

L always falls on line N_1N_2

P : Pitch point



SJE Gearing ٤

Involute Profile

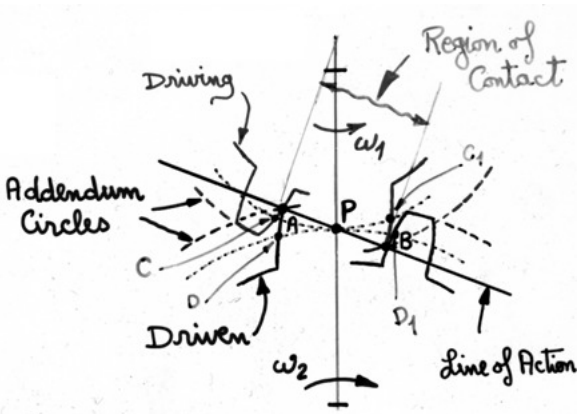
AB : Path of Contact

Points C & D meet at P

Arc of Action

- Driver : $\overset{\frown}{CPC_1}$
- Driven : $\overset{\frown}{DPD_1}$

$\overset{\frown}{CPC_1} = \overset{\frown}{DPD_1}$

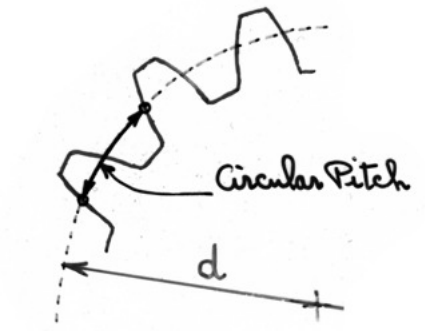


SJE Gearing ٥

Involute Profile

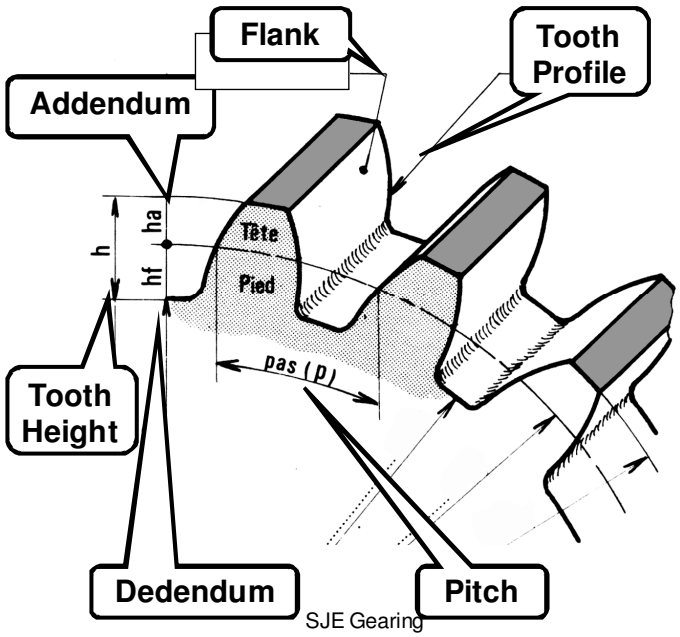
Circular pitch $p_c = \frac{\pi d}{z}$ ← Number of teeth

Module $= d/z$



SJE Gearing ٦

Gear Terminology



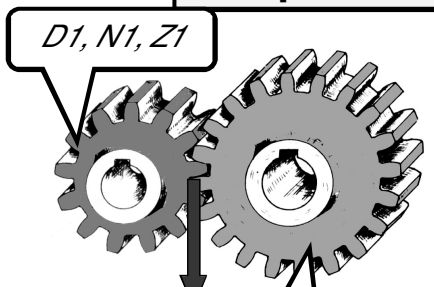
SJE Gearing ٧

Gear Terminology

Parameter	Pinion	Gear
Number of teeth	Z1	Z2
Diameter	D1	D2
Module (=d/z)	m	m
Addendum	m	m
Dedendum	1.2m	1.2m
RPM	N1	N2

SJE Gearing ٨

Peripheral Speed & Speed Ratio



mm RPM

$$v = \frac{\pi D_1 N_1}{60x1000} = \frac{\pi D_2 N_2}{60x1000}$$

m/s

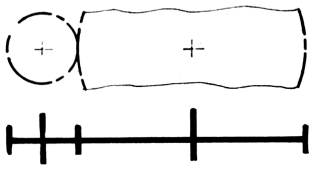
$$u = \frac{D_2}{D_1} = \frac{Z_2}{Z_1} = \frac{N_1}{N_2}$$

Speed Ratio

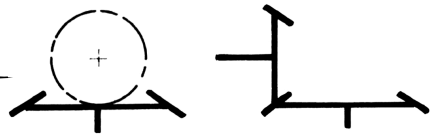
SJE Gearing ٩

Main Types of Gears

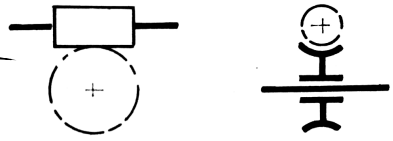
Cylindrical Gears
(Spur and Helical)



Bevel Gears



Worm Drives

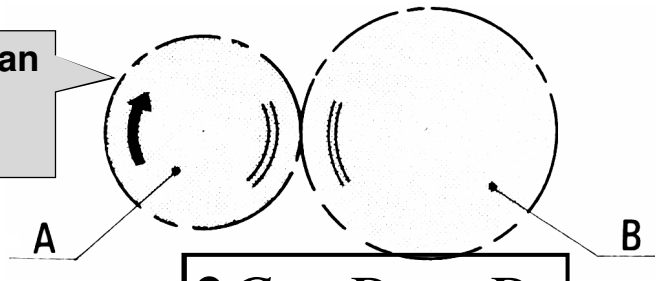


Rack and Pinion

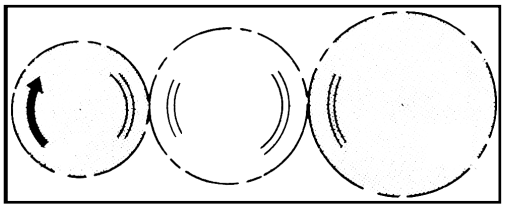
SJE Gearing ١٠

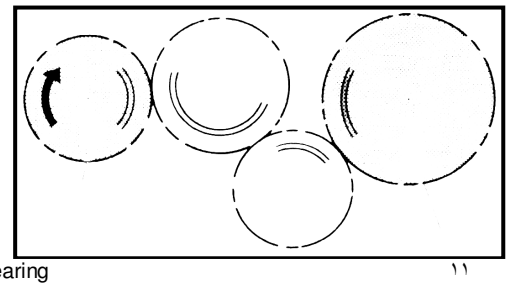
Sense of Rotation

Gear B will rotate in an *opposite* sense to pinion A



$$2C = D_A + D_B$$

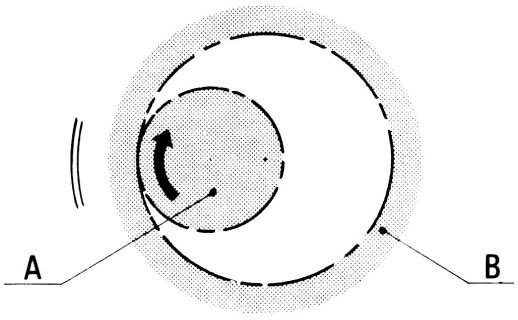


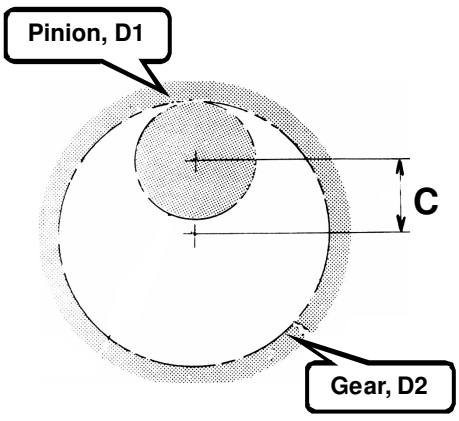


SJE Gearing ١١

Sense of Rotation of Gears
Internal Meshing

Gear B will rotate in the same sense as pinion A



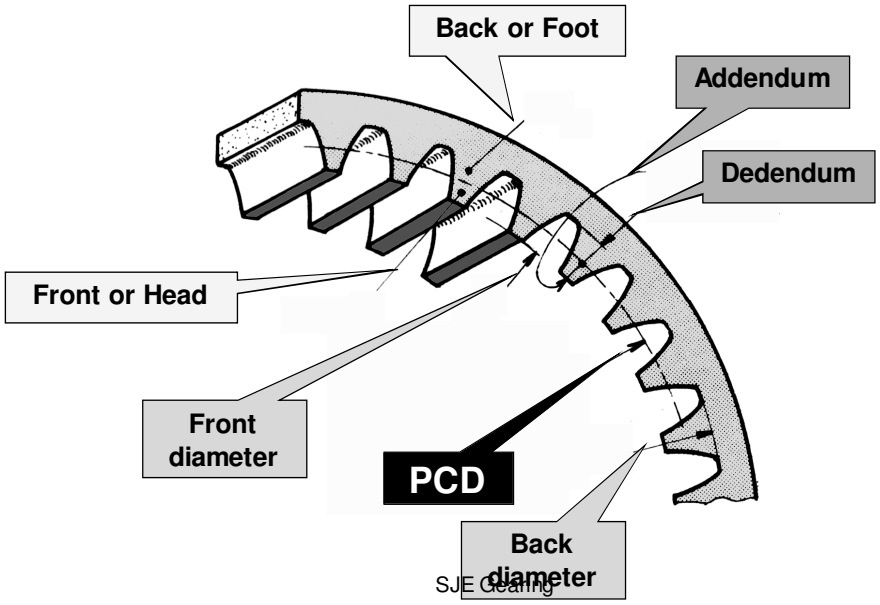


$$2C = D_2 - D_1$$

C = centre distance

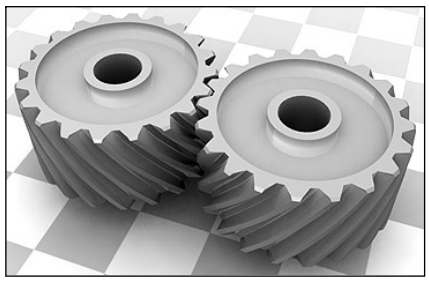
SJE Gearing ١٢

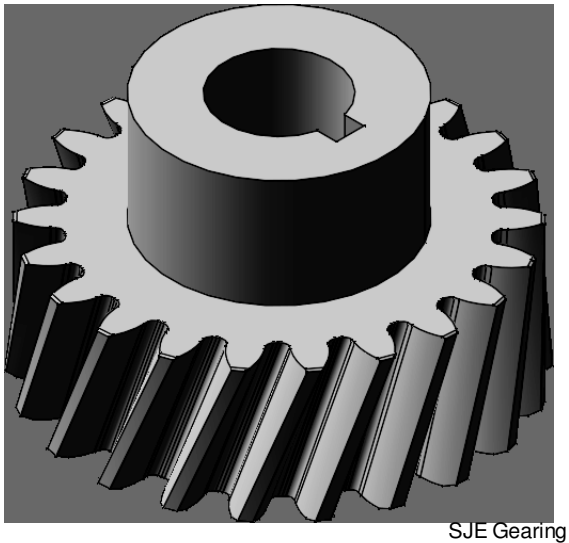
Internal Meshing



SJE Gearing ١٣

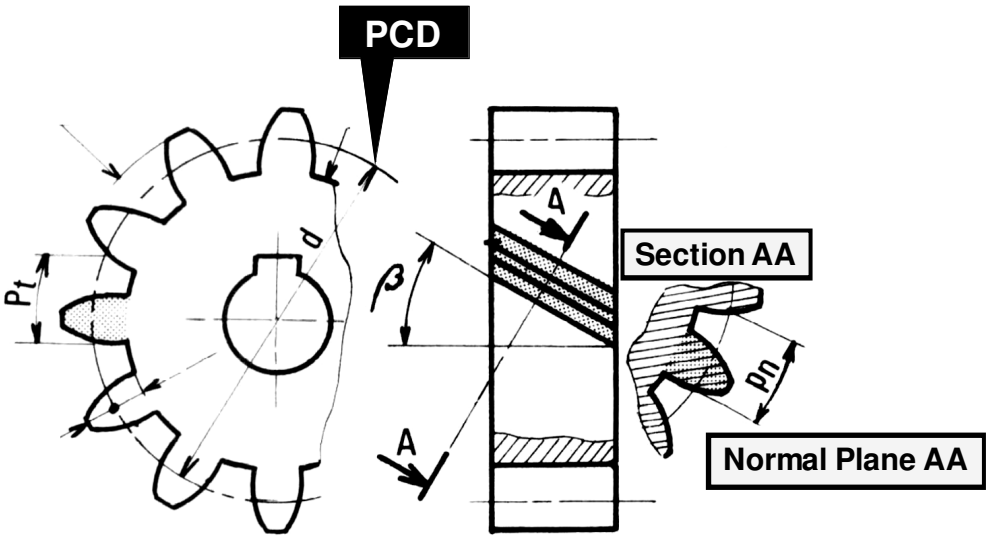
Helical Gears





SJE Gearing ١٤

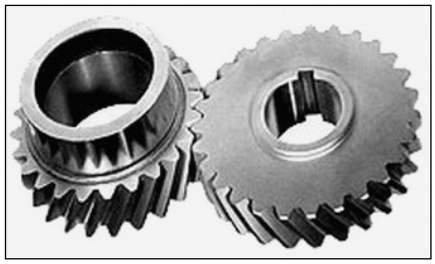
Helical Gears

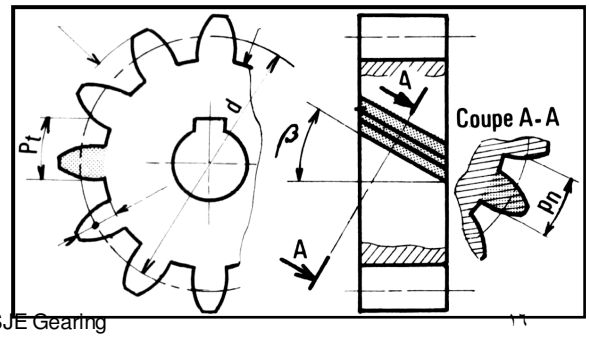


SJE Gearing ١٥

Helical Gears

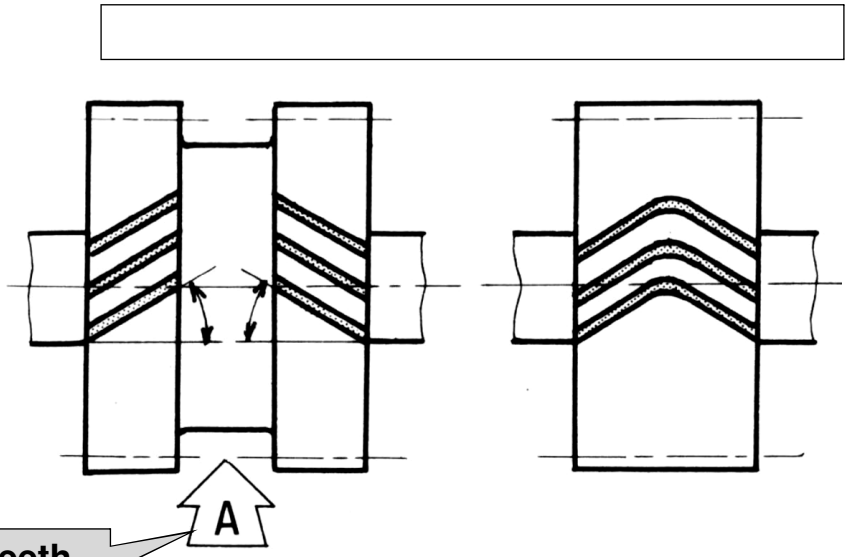
Parameter	Pinion	Gear
Number of teeth	Z1	Z2
Diameter	D1	D2
Module (=d/z)	m	m
Normal Module	m_n	m_n
$m_n = m.\cos\beta$		
Helix angle	β	β
Addendum	m	m
Dedendum	1.2m	1.2m
RPM	N1	N2
D = m . Z		
Pt = m . π		
Pn = Pt . cos β		





SJE Gearing ١٦

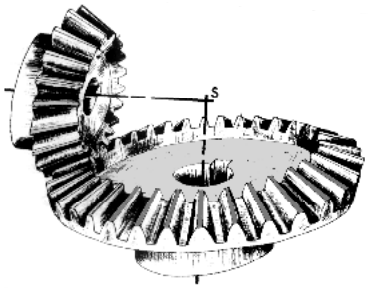
Double Helical Gears



Teeth recess

SJE Gearing ١٧

Bevel Gears

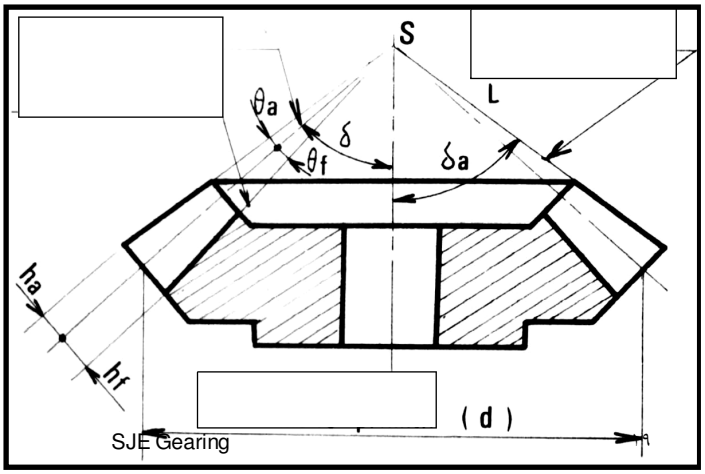


Spiral Teeth

SJE Gearing ١٨

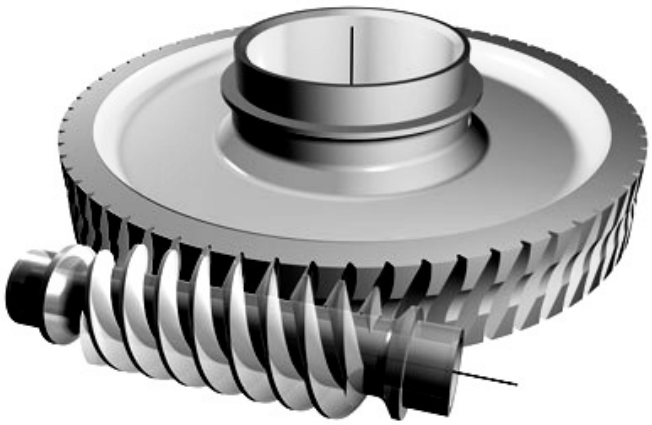
Bevel Gears

ha = m
hf = 1.2m
d = mZ



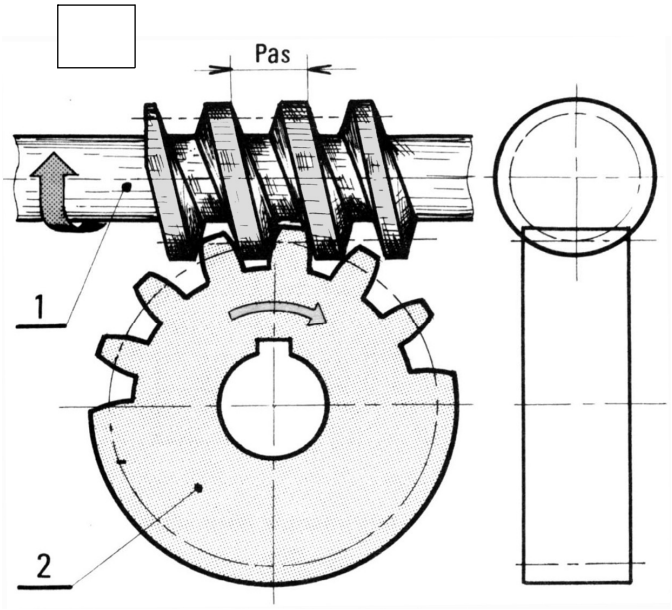
SJE Gearing

Worm Drives



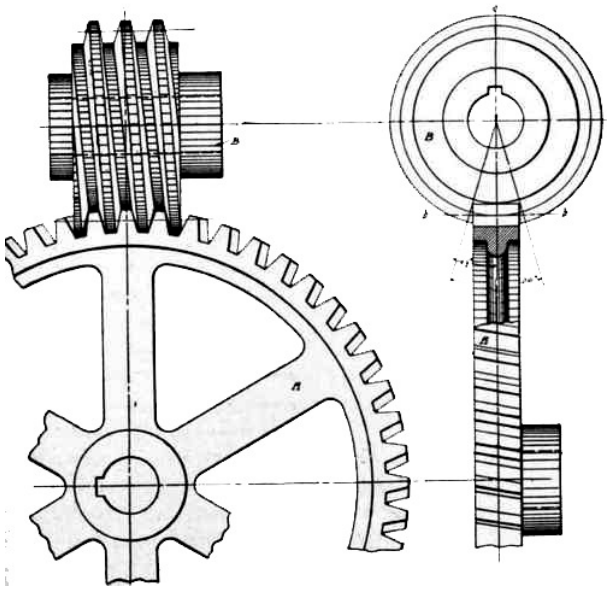
SJE Gearing ٢٠

Worm Drives



SJE Gearing ٢١

Worm Gears



SJE Gearing ٢٢

Gear Types

Type	Applications	Advantages	Disadvantages
External Spur	- Parallel shafting - Moderate speeds	- Moderate cost - No end thrust	- Small contact ratio
Internal Spur	- Parallel shafting - Moderate speeds - Same shaft directions	- Short centres - Large contact ratio - Partial safety guard - No end thrust	- Difficult mounting - Expensive
Helical	- Parallel shafting - High speeds	- Quiet operation - High load carrying capacity	- End thrust
Herring bone	- Parallel shafting - Heavy duty	- No end thrust - Large tooth contact - High load carrying capacity	- Expensive

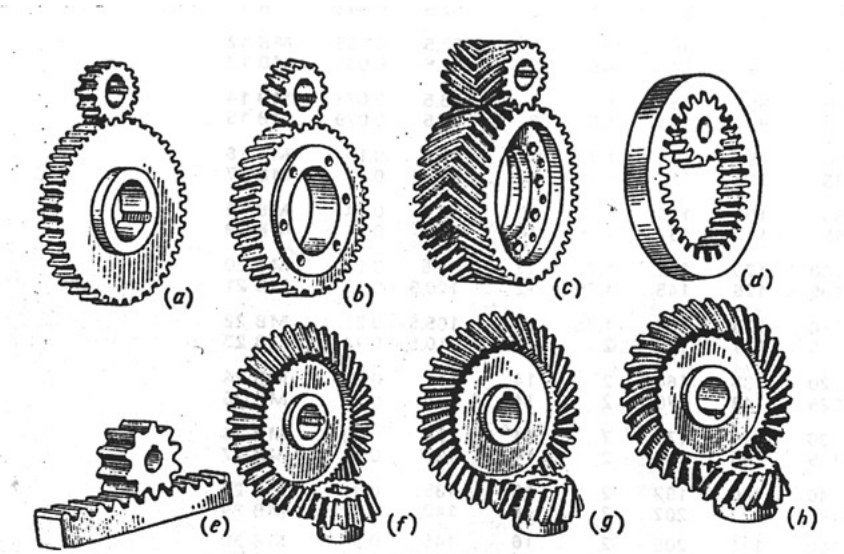
SJE Gearing ٢٣

Gear Types

Bevel	Straight tooth	- Angular drives - Moderate speeds	- Moderate cost	- Difficult mounting
	Zerol i.e No spiral angle	- Angular drives	- Long gear life - Smooth & quiet - Low stress concentration at tooth tip	- Expensive - Difficult mounting
	Spiral	- Right-angle drives - High speeds	- Good tooth meshing - High ld. carrying capacity	- Expensive - Difficult mounting
	Hypoid	1. Non intersecting shafts 2. Right-angle drives	- Mounting rigidity possible - High ld. carrying capacity	- Expensive
Worm Gears		1. Non intersecting shafts 2. Right-angle drives	- High ratios - Quiet operation - High ld. carrying capacity - Compact - Self locking possible	- Difficult mounting
Rack & Pinion		Rotary to linear or linear to rotary	- Compact	- Difficult mounting - Slow speeds - Small contact ratio

SJE Gearing ٢٤

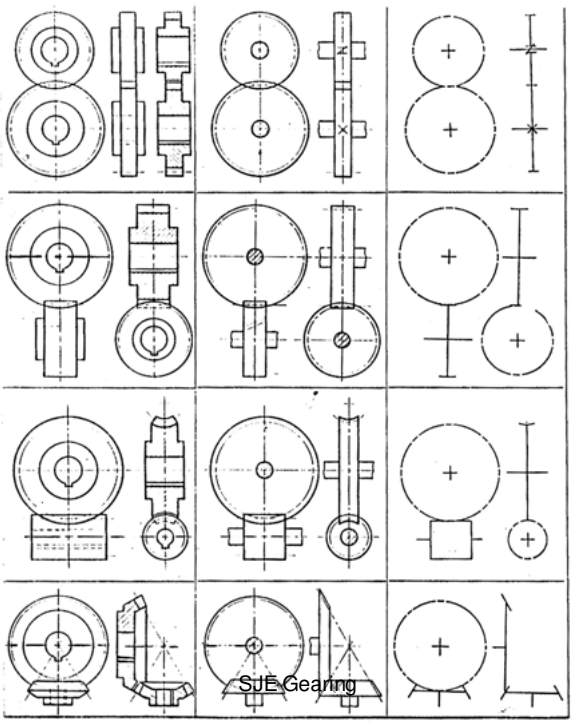
Gear Types



Principal types of toothed gears

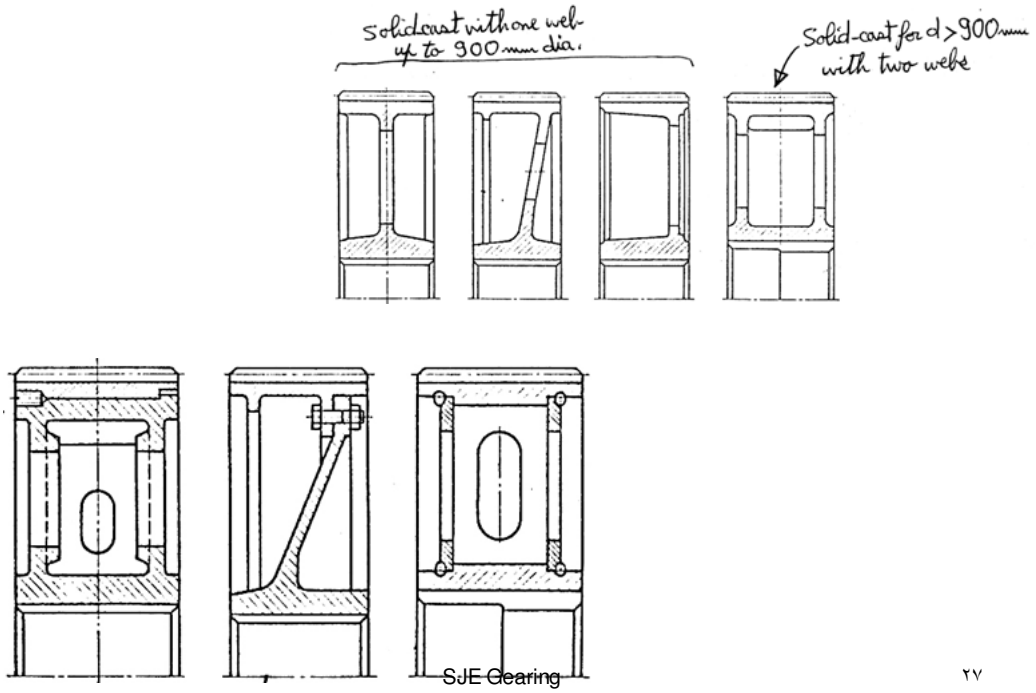
SJE Gearing ٢٥

Schematic Representation of Gears



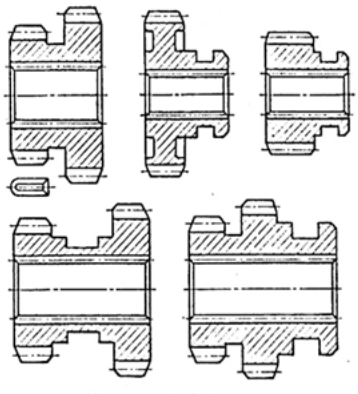
SJE Gearing ٢٦

Gear Wheel Construction



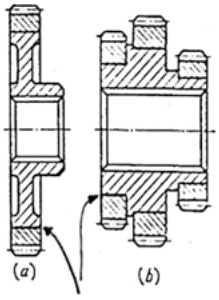
Gear Wheel Construction

Cluster gears are widely used in gearboxes. They are made by rolling or forging.



Cluster and sliding gears

Gear width could be decreased as there is no run-out for the grinding wheel.



Glue-jointed